TRENCH RESCUE

Awareness

Session 1

Suffolk County Fire Academy

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House-Keeping

- **Instructors**
- **Students**
- **Paperwork**
- **Student Manuals**
- **Exits**
- **Cellphones and Pagers.**

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Course Overview

2 Sessions

- **Session 1 – Introduction to Trench Rescue**
  - **Does It Happen Here?**
  - **Regulations and Standards**
  - **Introduction to Trench Operations**
  - **Worker Protection Systems**
  - **Case Studies.**

3

Course Objectives

- List information to be gained by interviewing witnesses or a "competent person" at a trench collapse incident (NFPA 1006, 12.1.1)
- Discuss the components of a nonentry rescue or victim self-rescue (NFPA 1006, 12.1.2, NFPA 2500 11.2.3)
- Identify hazard areas specific to a trench environment (NFPA 1006, 12.1.3, NFPA, NFPA 2500 11.2.3)
- List the information to be gathered from a trench rescue incident size-up (NFPA 1006, 12.1.4, NFPA 2500, 11.2.3).

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Course Objectives (Cont'd)

- Recognize incident hazards and the need to initiate isolation procedures (NFPA 1006, 12.1.5. NFPA 2500, 11.2.3)
- Recognize the need for technical rescue resources at an operations- or technical-level incident (NFPA 1006, 12.1.6, NFPA 2500, 11.2.3)
- Describe what is necessary to support an operations- or technical-level incident (NFPA 1006, 12.1.7, NFPA 2500, 11.2.3)
- Recognize typical trench and excavation collapse patterns, the reasons trenches and excavations collapse, and the potential for secondary collapse (NFPA 2500, 11.2.3).

5

Course Objectives (Cont'd)

- Recognize the unique hazards associated with the weight of soil and its associated entrapping characteristics (NFPA 2500, 11.2.3)
- Identify the methods for approaching and working around the excavation in a manner that minimizes the potential of collapse resulting from additional impact loads on the lip of the trench (NFPA 2500, 11.2.3).

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Session Objectives

- **Upon completion of this session the student shall demonstrate an understanding of:**
  - **Regulations, Standards, and Definitions**
  - **Soil Characteristics**
  - **Trench Anatomy**
  - **Characteristics of Different Trench Collapses**
  - **Trench Stabilization Systems.**

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Does It Happen Here?

8

Does It Happen Here?

North Babylon 2005

9

Does It Happen Here?

Huntington
2017

10

Huntington
2017

11

Does It Happen Here?

Rocky Point
2017

12

Does It Happen Here?

Saint James 2024

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Regulations and Standards

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Occurrences

- **Excavation is one of the most hazardous types of work done in the construction industry.**
- **When do these incidents occur (weather)?**
- **Primary Type of Accident = CAVE-IN.**

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Occurrences

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Occurrences

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Statistics

- OSHA
- 2022 = 39 deaths (typically ≈ 26/year)
  - ***Deadliest year in 18 years***
- 76% Caused by cave-in
- Most deaths occur in trenches 5ft – 8ft deep.

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Causes of Death

- Suffocation
- Crushing injury
- Loss of circulation
- Being struck by fallen object

Two Types of Trench Incidents:

Live Victims (Rescue) and Dead Victims (Recovery).

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Excavation vs. Trench

- **Excavation – man-made cut, cavity, trench, or depression in the earth's surface formed by the removal of that earth**
- **Trench – a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width (measured at the bottom) is not greater than 15ft.**

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Excavation

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Trench

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OSHA Standards

- 1926.650 – Scope, Application, and Definitions
- 1926.651 – Specific Excavation Requirements
- 1926.652 – Requirements For Protective Systems.

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OSHA 1926.652

- 1926.652 – Requirements For Protective Systems
  - 1926 sub. P, app. A – Soil Classification
  - 1926 sub. P, app. B – Sloping and Benching
  - 1926 sub. P, app. C – Timber Shoring
  - 1926 sub. P, app. D – Aluminum and Hydraulic Shoring
  - 1926 sub. P, app. E – Pictorial, Non-timber Shoring
  - 1926 sub, P, app. F – Flow Chart Compliance Options

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How OSHA Views Trench Rescue

- We over engineer our systems
- Our time in a trench is limited to rescue
- OSHA will become involved:
  - Civilian/rescuer injury
  - Death involving a construction accident
  - Request by AHJ.

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Non-Compliance

- Cost of protective systems
- Time = money
- Socio-economic and demographic issues
- Victims underestimate hazards.

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Non-Compliance

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Non-Compliance

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Competent Person

- **As defined in OSHA Standard 1926.650**
  - **A person who is *capable of identifying* existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees and who *has authorization* to take corrective measures.**

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Competent Person

- **Must have specific training in and be knowledgeable about soil analysis, the use of protective systems, and the requirement of the standard.**
- **Every excavation site (*including rescue operations*) must have a competent person as defined by OSHA.**

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Competent Person Responsibilities

- Must be able to identify:
  - Evidence of possible cave-ins
  - Failure of protective systems
  - Hazardous atmosphere
- Frequency of inspections:
  - Prior to start
  - As needed
  - Hazard increase.

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NFPA 1006

- Standard for Technical Rescue Personnel Professional Qualifications (2021)
- Establishes ***minimum job performance requirements (JPR's)*** for emergency response personnel who perform technical rescue operations
- "Technical rescue personnel shall remain current with technical rescue practices and applicable standards and shall demonstrate competency on an annual basis" (NFPA 1006, 1.2.7).

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NFPA 1006

- Core Requirements Include:
  - Site operations
  - Victim Management
  - Basic Ropes and Rigging
- Levels of Training:
  - Awareness – Non-entry operations
  - Operations – Non-intersecting, ≤ 8' depth
  - Technician – Intersecting and/or ≥ 8' depth.

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NFPA 2500 (New)

- Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services (2022)
- Encompasses the old 1670 standard
- Combines all technical rescue disciplines into one standard.

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Awareness Level

- Size-up existing and potential conditions
- Recognize the need for technical resources
- Identify resources to conduct safe and effective trench and excavation emergency operations
- Initiate the emergency response system for trenches and excavations
- Initiate site control and scene management.

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Awareness Level

- Recognize general hazards and the procedures to mitigate them within the general rescue area
- Recognize typical trench and excavation collapse patterns, the reasons trenches and excavations collapse, and the potential for secondary collapse
- Initiate a rapid, nonentry extrication of non-injured or minimally injured victim(s)
- Recognize the unique hazards associated with the weight of soil and its associated entrapping characteristics.

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Awareness Level

- Implement a hazard identification and isolation plan, including securing hazardous equipment, contacting utility location services, establishing control of affected utilities, and using methods for protecting bystanders and rescuers from accidentally falling into the excavation or increasing the likelihood of additional collapse
- Identify and implement methods of approaching and working around the excavation in a manner that minimizes the potential of collapse resulting from additional imposed loads on the lip of the trench
- Support and organization at the operations or technician level while functioning within the IMS.

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Arrival

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Introduction To Trench Operations

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Key Terms

- Max. Allowable Slope
- Cohesive Soil
- Compact Soil
- Excavation
- Loam
- Saturated Soil
- Running Soil
- Safeing
- Sloping
- Spoil Pile
- Stable Rock
- Tension Cracks
- Trench
- Virgin Soil.

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Soil Facts

- One Cubic Yard ≈ 3,000 lbs.
- One Gallon = 13 lbs.
- One Cubic Yard Will Fill 230, 1 Gallon Buckets.
- How much weight is on the victim?

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Soil Physics

- Sheer Wall Collapse Speed = 45 mph
- One Cubic Foot Of Soil = 100 – 120 lbs.
- 24” Of Soil On Chest = 750 – 1000 lbs.

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Cannot Out-run Dirt

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Soil Types

TYPE A	TYPE B	TYPE C
Most Stable	Less Stable	Least Stable
Load Rating ≥ 1.5T	Load Rating > .5T But < 1.5T	Load Rating ≤ .5T
Heavy, Strong Clay Cemented Soil Hard Pan	Granular Soil, Gravel, Silt, Loam, Sandy Loam	Granular Soils, Gravel, Sand, Sandy Loam, Clay
Not Fissured, Subject To Vibration Or Previously Disturbed	Can Be Previously Disturbed (But not Type C) Or Unstable Type A	Submerged Soil Or Soil From Which Water Is Freely Seeping

All Trench Rescues Are Considered Type C Soils

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Soil Types and Wall Collapse

TYPE OF SOIL	NUMBER OF FAILURES
Clay / Mud	32
Sand	21
Wet Dirt (Silty Clay)	10
Sand, Gravel, Clay	8
Rock	7
Gravel	4
Sand and Gravel	2

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Soil Classification

- **Compact – soil that appears compact or even hard and thus stable**
- **Saturated – soil from which you can see water actually seeping**
- **Running – loose, free flowing foil such as sugar sand.**

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Soil Testing

- Visual
  - Observe soil in and around excavation
- Manual
  - Plasticity
  - Dry Strength
  - Thumb Penetration
- Drying Test
- Pocket penetrometer
- Shearvane
  - Sedimentation test
  - Wet shake test.

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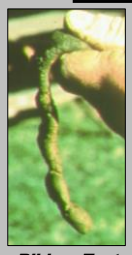
Soil Testing



Ribbon Test

Thumb Penetration

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Soil Testing

Dry Strength Test

Plasticity

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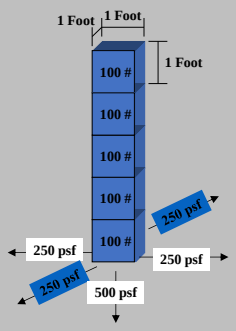
Weight and Pressure of Soil



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Victim Consideration

- **Medical**
  - **Crush injury**
  - **Suffocation**
  - **Fracture/dislocation**
  - **Hypothermia**
  - **Head, neck, spine**
- **Rescue**
  - **Non-entry/self-rescue**
  - **Uncover head and chest first**
  - **Do not try to pull the victim until they are completely unburied**
  - **Rescue vs. Recovery.**

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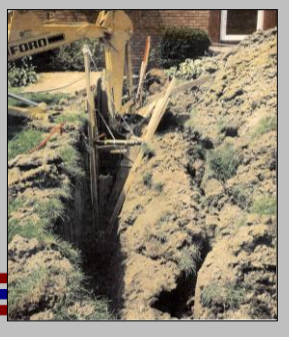
Why Do Trenches Collapse

- Weight of soil
- Soil type
- Tension cracks or fissures
- Hydraulic forces.



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Increased Potential For Trench Rescues

- Underground utilities
- Thousands of open trenches
- Lack of contractor training
- Lack of enforcement
- More complex underground engineering
- More construction
- "Johnny homeowner"
- Toxic atmosphere in trench.

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In What Depth Do Most Trench Rescues Occur?

5' – 8' Deep and less than 6' Wide

Why?

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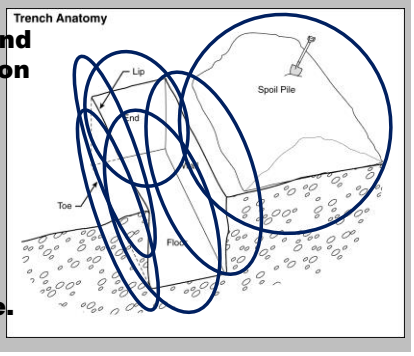
Anatomy Of A Trench

- Trench and Excavation
- Floor
- Walls
- Ends
- Lip
- Toe
- Spoil Pile.



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Cave-In Types

Spoil Pile Slide

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Cave-In Types

Slough or Belly Failure

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Cave-In Types

Shear Wall Failure

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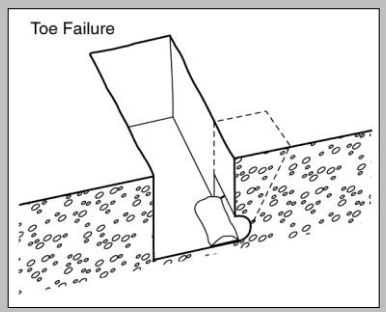
Cave-In Types



Toe Failure

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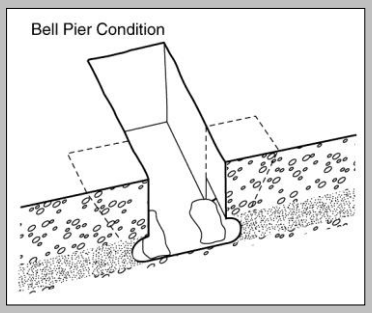
Cave-In Types



Bell Pier Condition

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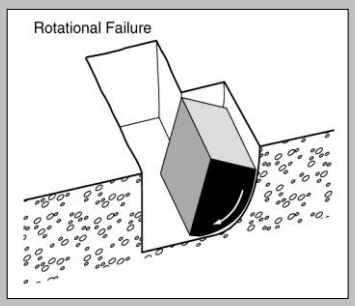
Cave-In Types



Rotational Failure

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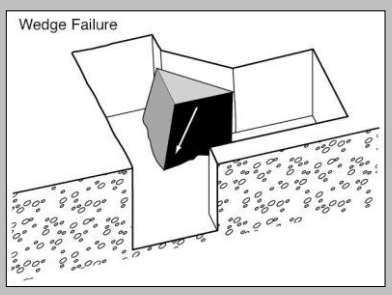
Cave-In Types



Wedge Failure

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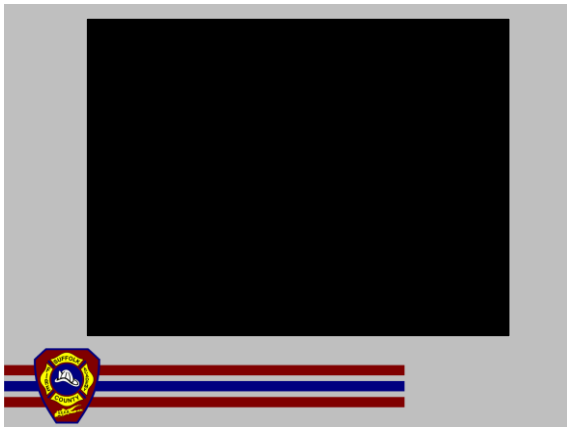

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Worker Protection Systems

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Why Do We Not Properly Protect Trenches?

- Time
- Money
- Training.

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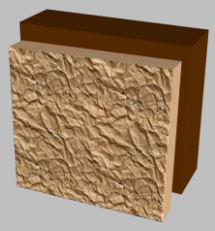
Worker Protection Systems

- Sloping
- Benching
- Shielding
- Shoring.



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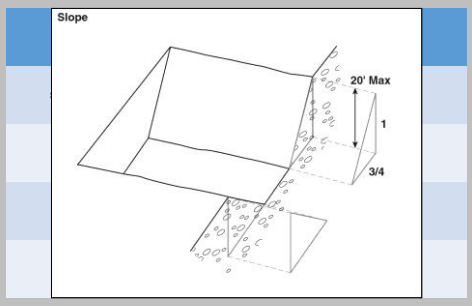
Sloping



Trench < 20'

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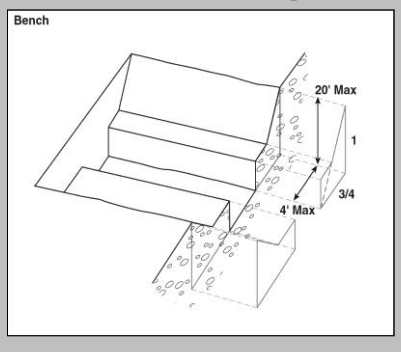
Benching



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Shielding

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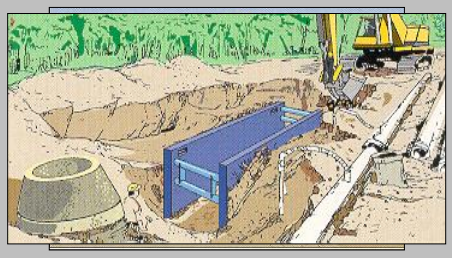
Shielding



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Shielding

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Shielding

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Shoring

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Pneumatic Shoring

- Type/indications for use
- Transfer of energy
- Overlapping zone of pressure
- Installation procedure
- Toe nailing.

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Timber Shoring

- Type/indications for use
- Transfer of energy
- Scabbing
- Rails and wedge use.

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Timber Shoring In Place

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Emergency Shoring In Place

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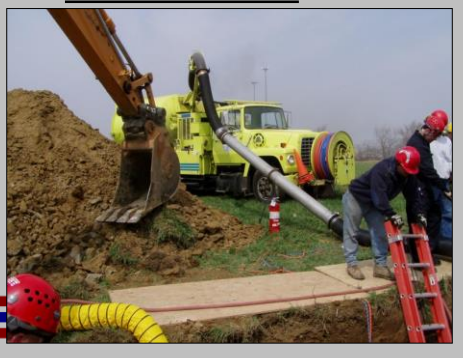
Vac-Truck



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Case Studies

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Grand Junction, CO – 2004

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Grand Junction, CO – 2004

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Greenwich, CT – 2007

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Greenwich, CT – 2007

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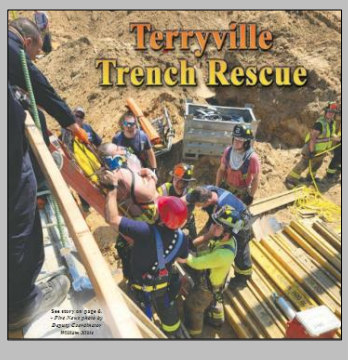
Terryville, NY – 2021



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Saint James, NY – 2024

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Saint James, NY – 2024

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North Babylon Case Study

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North Babylon Case Study

- Wednesday, May 20, 2005 13:40 hrs.
- Weather – Sunny and Clear (To Start)
- NBFCo. Signal 23 – Trench Rescue
- BCFA Automatic Activation of SCTRT.

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North Babylon Case Study

- Size-Up – Contractor Installing Sewer Line, Pinned
- TRT – Sidewalk Collapse and Trench Rescue.

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North Babylon Case Study

- NBFCo. IC – Brian Iudica
- NBFCo. Ops Chief – John Jordan
- Mutual Aid
  - Deer Park
  - Babylon
  - West Islip
- TOB Fire Marshal
- SCPD ESU
- 1-0-1

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North Babylon Case Study

- SCTRT Activation
  - FC 28
  - EFFD/WBFD
  - BFD
  - IFD
  - SCPD ESU
  - SCPD Aviation
  - SC EMS 1
  - SCEMS FC 20
  - SCEMS DMAT

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North Babylon Case Study

TRT Leaders | Operations | Logistics






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Side-walk Removal – 1.5 Hours



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Trench Operation– 1.5 Hours





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Summary

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Summary

- Trench/excavation incidents typically occur on sunny day following a soaking rain
- A "competent person" according to OSHA is required at every incident
- Awareness Level responsibilities are dictated by JPR's in the NFPA standards (1006, 2500)
- Soil can collapse at 45 mph and weigh up to 100 – 120lbs per cubic foot.

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Summary Cont'd

- All soil involved during a trench/excavation collapse is considered Type C (least stable)
- Trench rescues occur in depths between 5' – 8'
- A victim must be completely unburied before removal
- Technical rescue resources must be called immediately after confirming a trench/excavation incident.

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Questions?

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